Diameter pulses in the fetal descending aorta: physiological characteristics and changes after maternal smoking

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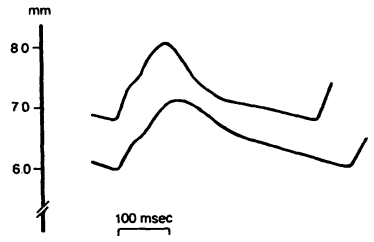
The quantification of the pulsations in the arterial vessel walls is a new opportunity to study and evaluate fetal cardiovascular functions. For this purpose we have used a newly developed electronic echo-tracker, built on the phase-locking principle of Hokanson (1), connnected to a real-time ultrasound scanner (2). The equipment yields an analog output signal representing the instantaneous vessel diameter at a chosen level; after analog-to-digital conversion the signal is evaluated off-line by means of a microcomputer.

Initial studies aimed at establishing the physiological distribution of the waveform and the propagation velocity in the fetal descending aorta during the third trimester of an uncomplicated gestation (3). The sonic monitoring imposes no constraints on the vessel movements and has consequently yielded data different to those obtained by earlier invasive methods (4). The diastolic diameter was positively correlated to the gestaional age, the relative pulsatile increment of the transsectional vessel area remained constant during the period studied when related to the estimated fetal weight. When travelling down the aorta, the pulse changed its waveform to a steeper initial ascent. The pulse amplitude was positively correlated to the duration of the preceding heart beat interval, a finding suggesting that the Frank-Starling law is valid also for the fetal heart contraction. The acute effects of maternal cigarette smoking on the pulse waves in the fetal descending aorta were marked: an increase of the diastolic diameter, a shortened but steeper upstroke of the ascending leg, and a decreased late decremental slope appeared (Figure).



These changes were transient and occurred within 3-10 min efter the start of smoking a single cigarette following 12 hours of abstinence from smoking. The altered waveform after smoking could not be quantitatively explained by the simultaneous increase of the fetal heart rate. The observed post-smoking changes in the fetal pulse waves are consonant with the vasoconstricting and positive inotropic effects on the cardiovascular system elicited by a nicotine-induced activation of the adrenergic system.

Recently, we have begun to investigate fetal pulse waves in complicated pregnancies. In five out of six consecutively studied cases with intrauterine growth retardation and no maternal hyper-

tension, the pulse propagation velocity in the descending aorta was increased above 2 SD over the mean of a clinically normal group. As it has been shown that a raised intravascular pressure augments the propagation of pressure pulses along the vessel (5), these preliminary data suggest a high systemic blood pressure among some growth-retarded fetuses in utero.

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